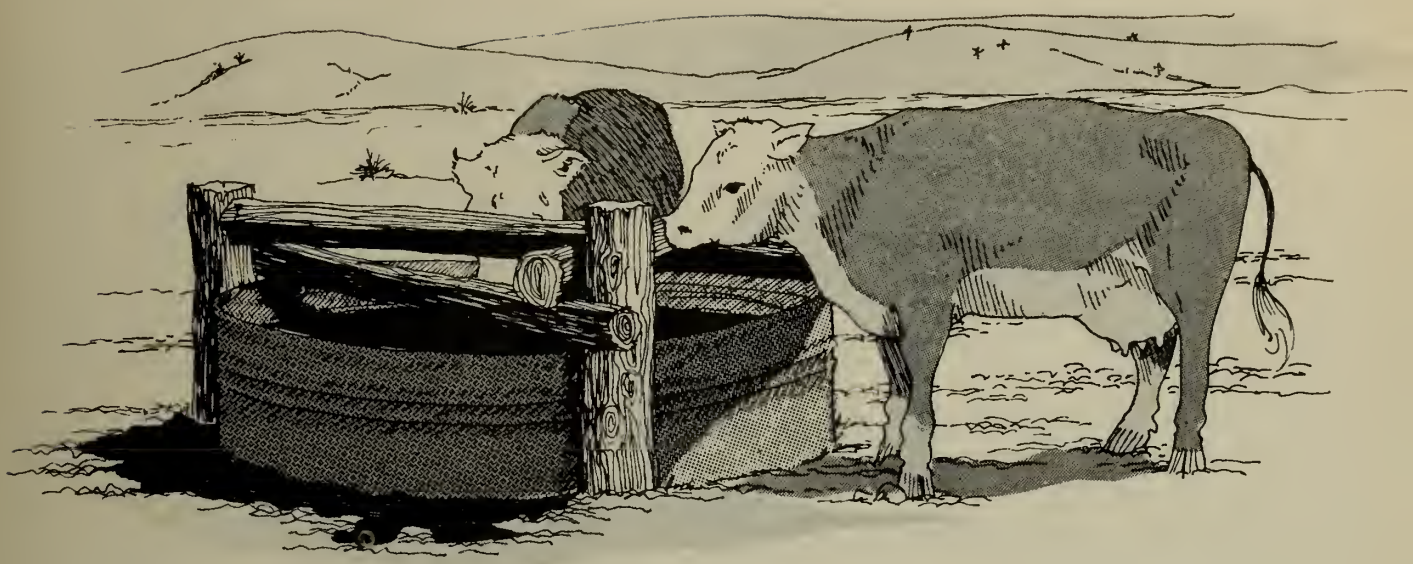
BLM LIBRARY
88012831

LIBRARY



SPRING DEVELOPMENTS

A DISCUSSION

Prepared By

L.E. DUNCAN, CHIEF, DIVISION OF OPERATIONS
Burns District, Oregon

-1973-

Distributed By
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
OREGON-WASHINGTON STATE OFFICE

GB
1199.2
.D84
1973

PROPERTY OF
Bureau of Land Management
D S C Library
FEB 8 1977

GB
1198.2
.D86
1973

SPRING DEVELOPMENTS
A DISCUSSION

Prepared By

L. E. Duncan, Chief, Division of Operations
Burns District, Oregon

-1973-

Distributed By
United States Department of the Interior
Bureau of Land Management
Oregon-Washington State Office

BLM Library
D-553A, Building 50
Denver Federal Center
P. O. Box 25047
Denver, CO 80225-0047

BUREAU OF LAND MANAGEMENT LIBRARY
Denver, Colorado
88012831

PROPERTY OF
Bureau of Land
D S C

FEB 8 1977

SPRING DEVELOPMENTS - A DISCUSSION

PURPOSE

Concepts and practices of spring development have changed in recent years as a result of advancing technology and increasing public concern about the environment. The basic purpose of this presentation is to refresh and update the experienced and provide guidelines for the inexperienced.

DEFINITION

A spring is a natural outflow of water from the ground surface. A seep is a spring with a flow so limited that a distinct channel of water cannot be observed. An outflow may be a spring during certain times of the year, a seep during dry seasons and stop entirely during periods of drought. Variations are practically limitless.

HISTORY

The knowledge and utilization of springs is as old as man. Usage has and is being made of all types of springs by all facets of civilization from the most primative to the most sophisticated. The basic reasons for use have not changed through the ages. Wet areas provide moisture for animals thereby providing a hunting area for man and other predators. The presence of water may provide a suitable habitat for edible plants.

USE

Water is normally developed for a single purpose, i.e. stock-water. After installation, however, it is found that other uses occur. Additional uses will include wildlife and may extend to recreation, fire suppression, and irrigation.

The amount of water available will determine the maximum allowable use towards which it can be put. A spring cannot be developed to produce more water than is available at its source regardless of the needs of the surrounding area. It should be remembered that many aspects of the area's environment are controlled by the availability of water and will not be substantially changed by development.

Moisture that was formerly dissipated into the surrounding soil, plants or simply evaporated, may be collected for use. Water collected may be utilized to increase the season of use. Similarly, early season seeps can be developed to provide water for early stock turnouts to areas previously unused.

GEOLOGY

Geologic features favorable to the formation of springs are: faults, grabens, synclines, and dikes. Gravity springs can be classified as depression, fracture, or contact.

Depression springs result when ground surfaces intercept a water table in permeable material. This type of spring is extremely

sensitive to seasonal precipitation and may be intermittent.

Fracture springs occur when water emerges from fractures, joints, or tunnels in rock. Dependability of supply is somewhat better since it generally originates from the more stable water table.

Contact springs are caused when the downward flow of a water table is deflected to the ground surface by a layer of impervious material. Contact springs also tend to be more permanent in nature than the depression type.

Artesian springs can be classified as outcrop or fault. Artesians result from the water table lying at a relatively high elevation and being channeled downward between two impervious layers through a permeable material to the ground surface.

ARCHEOLOGY

Springs are old in terms of man's existence. They provided a source of water and food for past civilizations and therefore artifacts have tended to accumulate at such sites. Artifact accumulations are valuable as sources of information for archeologists in tracing the cultural development of man. Care must be taken to prevent damage to sites containing cultural artifacts until examination can be accomplished by properly qualified individuals.

The Curator of Archeology, Museum of Natural History, University of Oregon, is the qualified authority designated by the Bureau of Land Management for the State of Oregon.

ENVIRONMENT

Emphasis during planning and construction should be made to enhance the environment. Special attention should be given to actions which will avoid or minimize contamination of the water, destruction of downstream values and aesthetically displeasing construction.

Analysis of the environmental impact of developing a spring can result in the disclosure that the benefits of development outweigh detrimental factors. This may result through protecting the source from contamination, providing clean water for consumption, providing protection for small wildlife, etc.

Compliance with environmentally oriented laws and regulations can best be done by personnel at the local level. Analysts should come from the ranks of various disciplines such as wildlife biology, watershed protection or management, geologists, archeologists, range or forestry specialists. Managers proposing the project being analyzed should not be involved in the analysis because of the very human tendency to justify the project. The situation should be avoided whether or not the particular manager can be truly objective because the reader of such a document will suspect the author or co-author of having a vested interest.

Although development can be beneficial it must be remembered that disturbance of the soil and/or vegetation will affect the ecology of the area. The way to minimize disturbance to the ecosystem is to minimize the size of the area necessary for development. For example, track-type tractor should not be used if a rubber-tired backhoe can be employed. The cost of mechanical development should be weighed against ecological benefits to be gained by hand development.

LEGAL ASPECTS

With the advent of more and more people visiting public lands, an awareness has been created that the Bureau has an obligation to that public not to create unsafe conditions. Water provided for stock may not be healthy for humans. The act of providing a quantity of clean water in a trough that is easily available to stock is also providing water convenient to the public. Those spings situated in remote, hard to get to places do not have as high a risk for the public. The public should be made aware of the potential danger for those developments that are easily accessible. Depending upon the situation, the facility should at least be signed and perhaps tested on a regular interval. Signing should indicate that the water is not fit for human consumption and, if it is tested, at what intervals the testing is done. Advice of the solicitors should be sought to determine the extent of the risk for developments where a question exists.

ECONOMICS

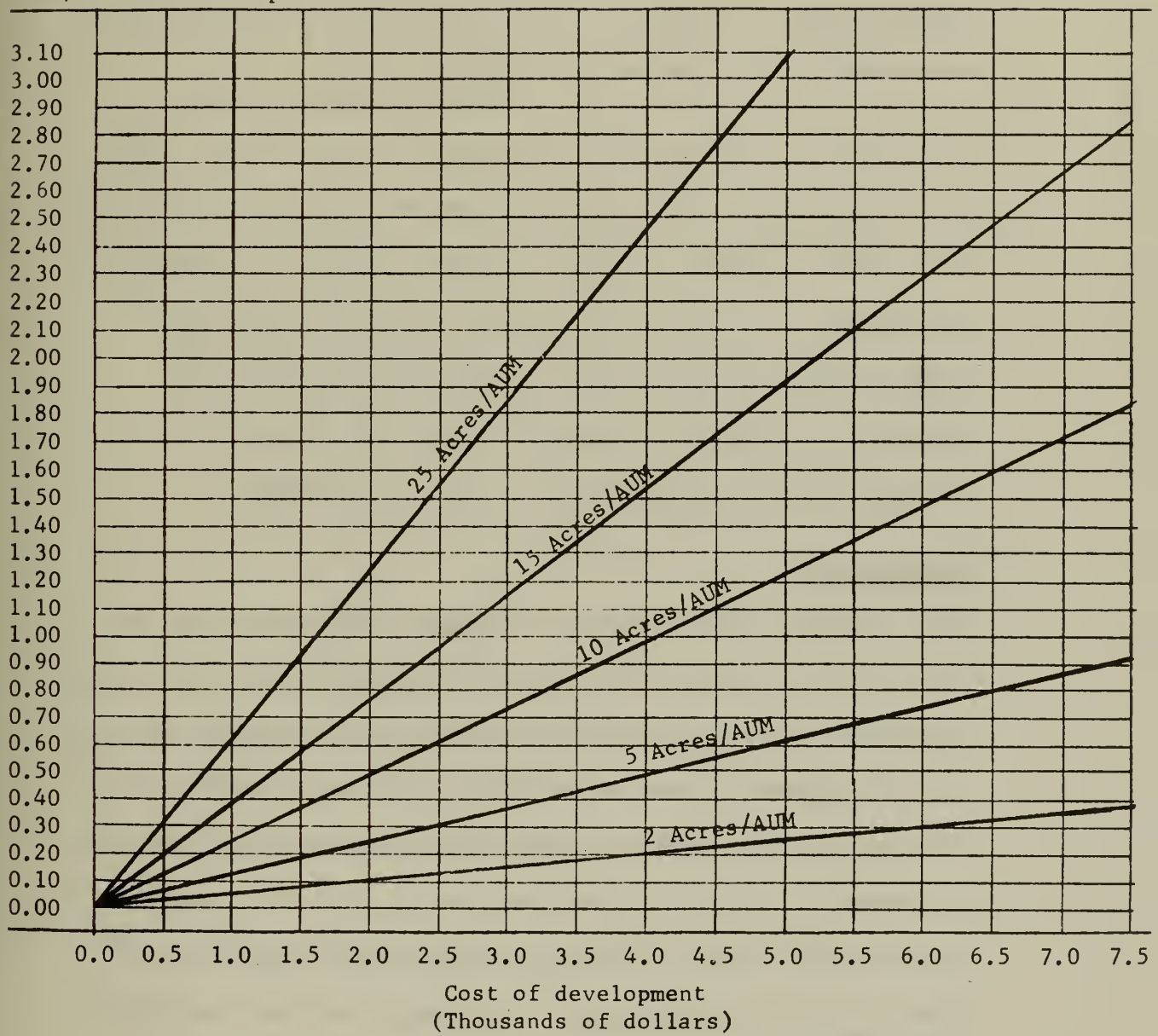
One primary question should be asked prior to any development, including springs. Is the investment economically justifiable in terms of the total cost? This includes initial investment, interest and maintenance over the lifetime of the project, considering alternative methods of water production. The graph shown below, although not entirely accurate, may provide the answer to two parts of the question; that of comparing costs with other types of development, and of the cost of initial investment.

The cost per investment graph is a chart indicating the ratio of capital investment to cost per animal unit month over the projected life of the project. It assumes that an individual watering facility will provide water for stock grazing in a half section area (320 acres); a use period of five months, and a project life of 25 years. The graph may be modified to include interest, maintenance, depreciation, inflation, etc.

Maintenance costs can be controlled by avoiding the false economy of cheap construction. Maintenance of most springs require at least one day in the field for each system break down. The dollar value each day of maintenance can amount to as much as 15 percent or as little as five percent of the initial investment.

Four or five breakdowns to a spring system amount to a substantial portion of the initial investment. Cheap construction is not necessarily economical.

Cost/Investment Graph



PLANNING

Planning should be thorough and on a schedule basis prior to construction so that cost estimates are reasonable and the final project workable. Planning must be accomplished far enough in advance to insure proper consideration of all facets of development down to the smallest detail.

Each spring must be planned individually since conditions change from site to site. This concept is similar to wells or road construction in that sub-surface conditions cannot be determined accurately in advance of exposing the site by excavation. Because of the inability to see sub-surface conditions, the necessity for alternative courses of action in the collection area must be built into planning for each development.

INVESTIGATION

Each site must be investigated thoroughly to determine type and size of source, approximate volumes, placement of facilities, soil, vegetation, collection and disposal area sizes, accessibility, etc. The investigation should be done during the later portion of the dry season so that minimum volumes can be determined for use computations. A check of the maximum flow should also be made to prevent under design of flows which could cause damaging overflows in the utilization area. Local people may have useful historical information on flows.

On site examinations should include specific measurements to aid in developing cost estimates and in preparing the environmental analysis. Legal questions of water rights, contamination and access must be determined at this time.

All information determined during the investigation should be documented in a legible manner and be available throughout the planning and execution stages.

DESIGN

Criteria for design can be divided into three areas: (A) Collection Area, (B) Utilization Area, and (C) Overflow Area:

(A) Collection Area - This area is noticed because water or the evidence of water, is observed at a point removed from lakes, ponds, streams, etc., although they may occur there also. The area observed is the apparent source. The essential objective is to collect all water emitting from the source without plugging or disrupting the prime source of flow. Location and the extent of the source or sources must be determined very carefully with a hand shovel or backhoe. Collection of the water after the development of the source can be accomplished either with perforated pipe or a headbox or a combination of both.

A cut off trench must be constructed immediately down stream of the collection terminal to insure collection and retention of the maximum amount of water available.

Even though utilization may not be made of all the water collected, insurance will have been made to prevent bogs from being formed in the area. Effort should be made to re-establish vegetation on the disturbed area to prevent erosion and present an attractive, pleasing sight to the public.

(B) Utilization Area - This area is centered around the watering trough. Major items to be considered to obtain optimum design are: anticipated uses, capacity, and maintenance.

There will be many different users even though development justification may be based upon a single use. Small animals and birds need ramps in and out of the water with reasonable slope and adequate traction. Adequate areas must be allowed around the trough for stock to water safely and efficiently without damage to the facility, themselves, or adjacent structures. Inlet design should be accomplished in light of whether or not man is to be encouraged to use the water. This may determine the position of the inlet in relation to the water level in the trough.

Water supply is limited by the quantity available at the source. Additional usable water can be obtained

by increasing storage capacity. Quantities of water available for use are generally more than required. The difference can be utilized through storage.

Maintenance considerations in the design of the utilization area are materials, workmanship, drainage, stability and location. Spring location in relationship to other objects can produce pressure by stock on these objects. Location of troughs on steep side slopes, and drainage channels should be avoided.

The trough must be stabilized from vertical or lateral movement. Displacement of the trough causes rupture of inlet and outlet lines, which renders the facility useless.

Drainage is necessary to reduce deterioration to the trough by rusting, insure access to water by stock, especially the young, and to prevent displacement of the trough.

Finally, the area must present a pleasing picture to the eyes of the public after construction.

(C) Overflow Area - This is an area where excess water is returned to the original channel. The area should be protected in a positive manner to prevent damage

to the overflow outlet through trampling. This type of damage causes overflow of the trough and eventual trough displacement. Protection and revegetation of the overflow area may provide protection for small animals. Cutting of new channels with overflow water must be prevented to retain valuation of downstream values.

MATERIALS

A complete compilation of materials available for spring development would be infinite. Satisfactory selection of material should be based on a combination of factors including but not limited to life expectancy of the project, purpose, and aesthetics. An example of poor material selection might be that of using wood or unprotected metal on moist ground when the life expectancy of the project is 25 years. Another common error is the use of light metal troughs where there is considerable pressure from stock. Handy creek gravel is another tempting pitfall. This source of aggregate is cheap but it is also likely to be dirty and most certainly it will be ungraded. The value of stream gravel as a concrete aggregate cannot be determined by visual examination.

Springs are in areas of moistness therefore all materials used should be resistive to damage from prolonged wet and dry spells. Wood should be treated, steel or iron galvanized, or painted with rust resistant substances, and plastics such as polyethylene should

be used where feasible.

WATER RIGHTS

Oregon law states that if the waters of a spring flow in a well drained channel and off the property upon which they first arise, they are public waters and subject to general appropriation. Care should be taken not to develop springs prior to investigation of water rights. It may be determined that the water has been appropriated previously by a downstream user. Developments should be protected by filing. Riparian rights vary from state to state and should be thoroughly considered during the planning stages of the development.

ACCESS

Access to a job for development can be accomplished by several methods, the most common of which is road construction. There are other means available and which may be more economical and ecologically acceptable. Equipment, tools and supplies may be brought to the project by rubber-tired tractors, track-type tractors, four-wheel drive vehicles, helicopters or even horses depending upon the individual situation. Road construction may be the most ecologically damaging factor in the development of a spring.

If a road must be constructed, the job should be planned. Planning and subsequent construction should provide location, horizontal and vertical alignment and drainage. Damage should be

minimized to soil and vegetation during construction.

The road should be "put to bed" after the project is constructed by placing the disturbed soil back as near as possible to its original profile and revegetating. All measures should be taken to prevent further damage to the environment after development.

Another factor of access is the legal right of entry. Where access to the project is or will be constructed across private property, the legal right to use that road or land is necessary. The Bureau requires legal access be obtained for entry to capital improvements. This oversight may force relocation of a road or a condemnation for right of way to an existing project. Properly executed legal access must be acquired prior to construction to be assured of avoiding embarrassing situation.

SUMMARY

Aspects of spring development have been dealt with summarily here since the objectives were to refresh or introduce the various factors involved to the reader.

Springs and their utilization for man's benefit are unique since little work is required to realize the benefit.

Care must be exercised against creating damage to the environment that will offset the immediate gain obtained. This can be accomplished through thorough, detailed, advanced planning of all facets of development. The final step is to follow through the construction phase to assure that the goals of planning are achieved.

BUREAU OF LAND MANAGEMENT
REFERENCES

1. Format for Environmental Analysis (W.O. - IM No. 72-135, 4/14/72; and, W.O. - IM 73-4, 1/5/73).

2. Range Resource Water Quality (Oregon Manual Supplement 9/24/70).

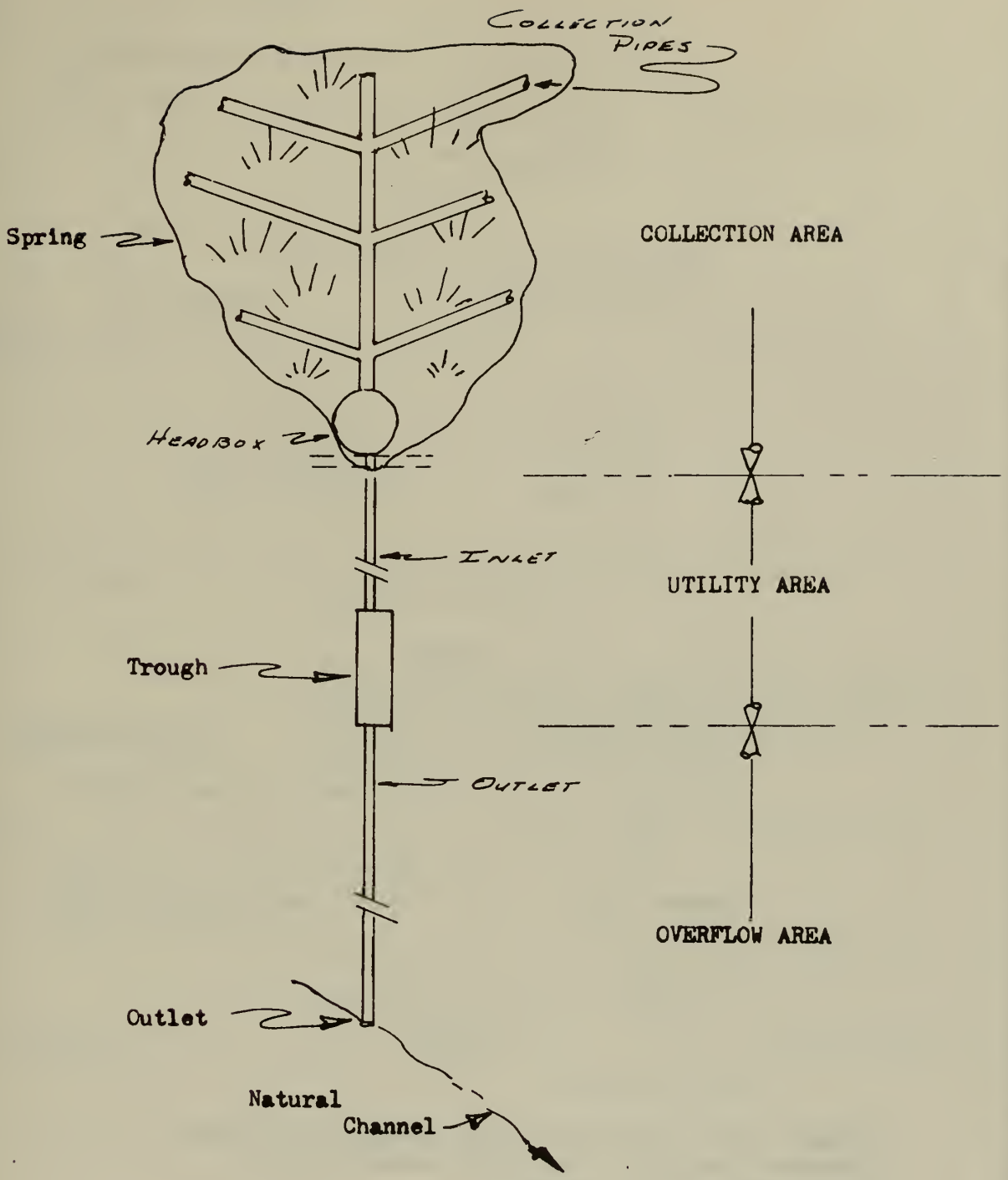
3. Water Filings (Oregon Manual Supplement, 5/28/64).

4. Water Management Development (Oregon Manual Supplement, 2/17/71).

5. Water Developments (BLM Manual 6/28/72).

TYPICAL ILLUSTRATIONS

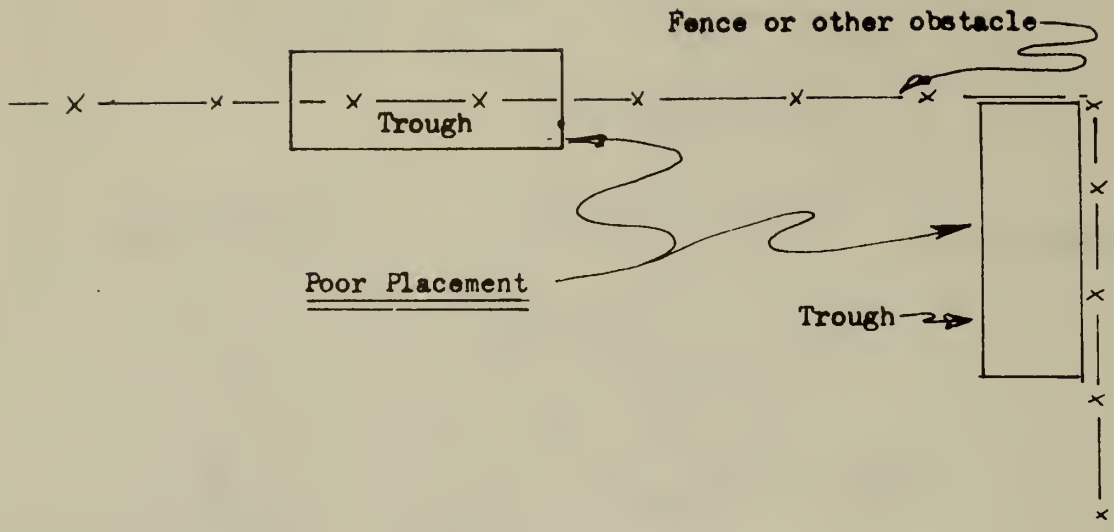
APPENDIX I

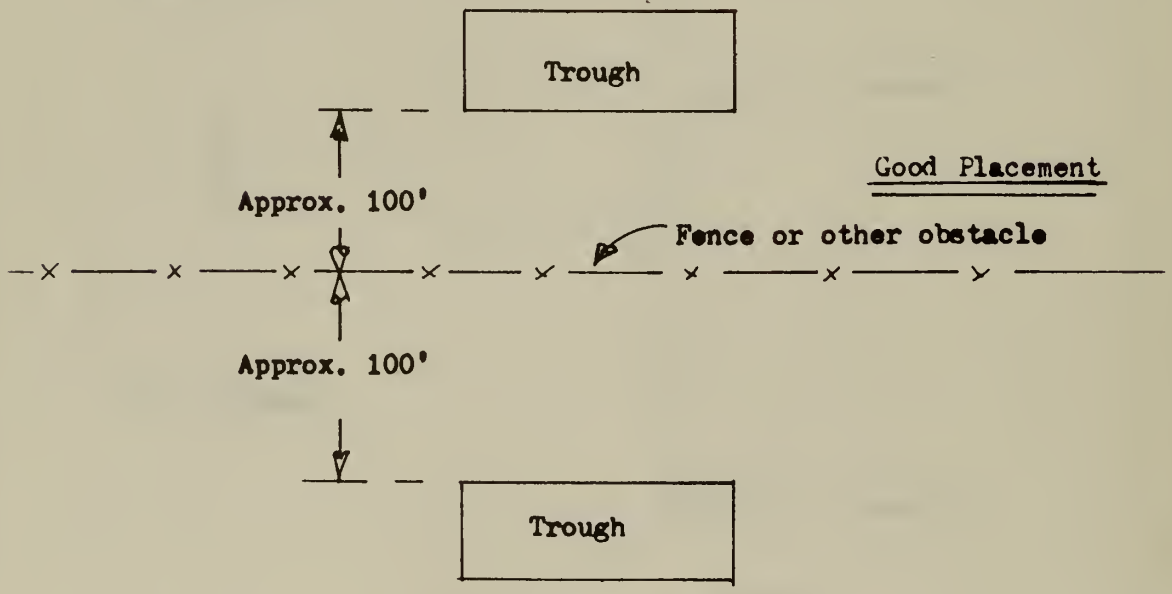


Typical Spring

I-a

☆ GPO 853-660



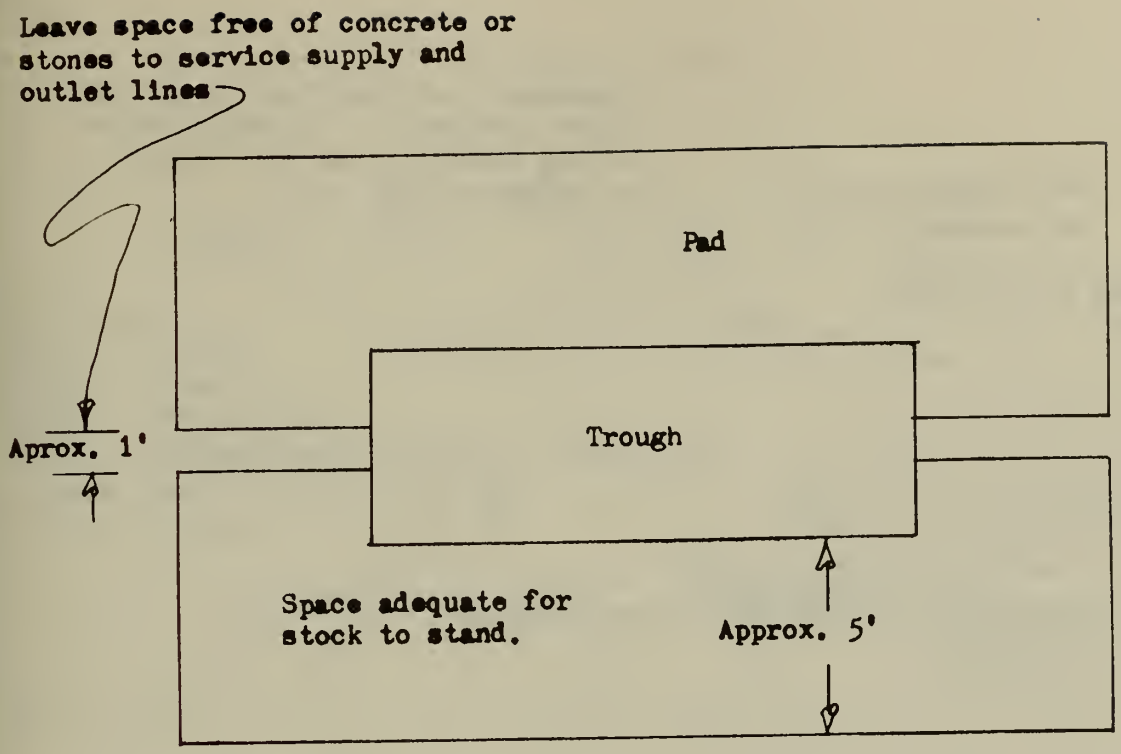


Adequate space around troughs is necessary to prevent excessive trampling of the area, damage through displacement to the troughs and damage by similar means to the fence, buildings or other obstacles.

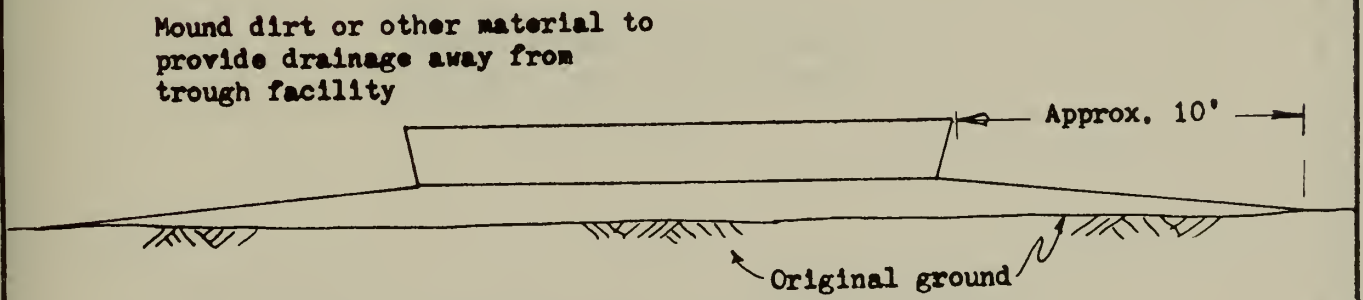
Trough Placement-1

I-b

☆ GPO 853-660


Leave space free of concrete or stones to service supply and outlet lines
Pad
Trough
Aprox. 1'
Space adequate for stock to stand.
Approx. 5'

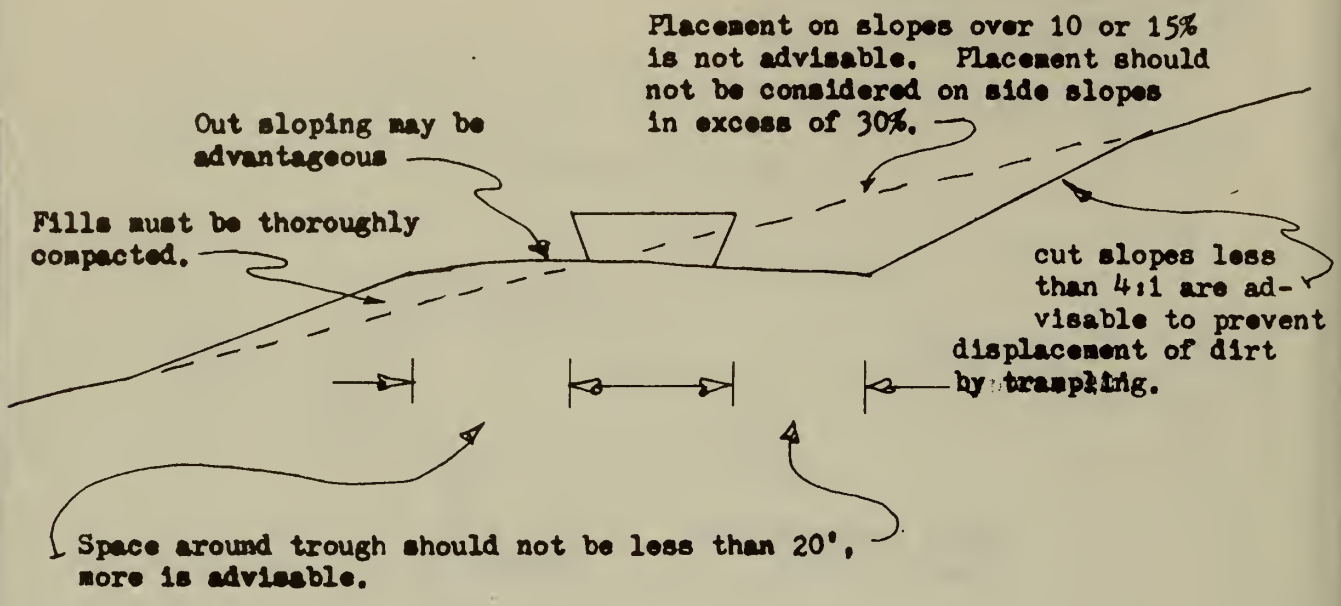
Where concrete is used for pads wire re-enforcing mesh should be used. Concrete should be good quality with an extremely rough surface to provide good traction for stock.



Trough Placement-2

I-c

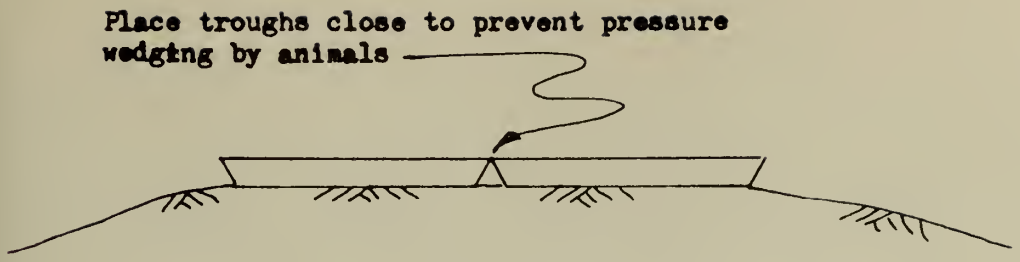
☆ GPO 853-660

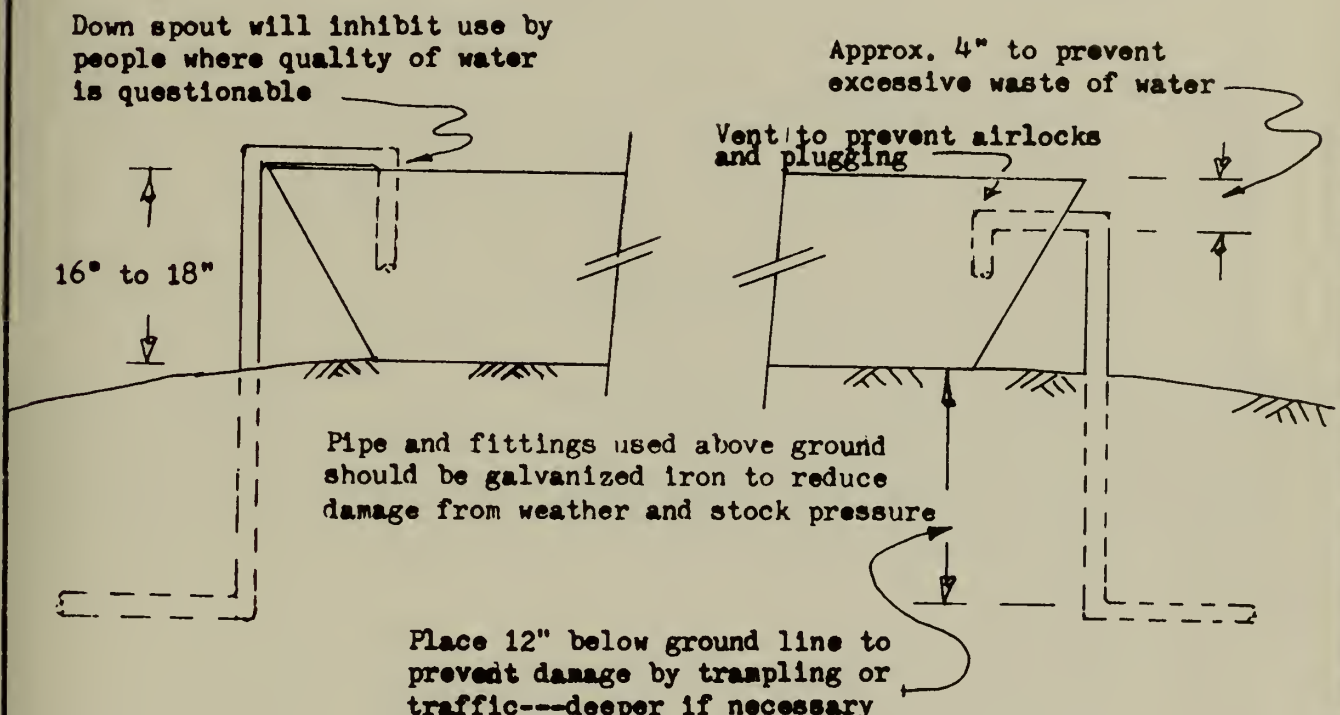

Placement on slopes over 10 or 15% is not advisable. Placement should not be considered on side slopes in excess of 30%.
Out sloping may be advantageous
Fills must be thoroughly compacted.
cut slopes less than 4:1 are advisable to prevent displacement of dirt by trampling.
Space around trough should not be less than 20', more is advisable.

Trough Placement-3

I-d

☆ GPO 853-660




Down spout will inhibit use by people where quality of water is questionable
Approx. 4" to prevent excessive waste of water
Vent to prevent airlocks and plugging
16" to 18"
Pipe and fittings used above ground should be galvanized iron to reduce damage from weather and stock pressure
Place 12" below ground line to prevent damage by trampling or traffic---deeper if necessary to prevent freezing

Vent holes should be large enough to prevent plugging with small grass and straw finding its way into the trough. A ½" minimum is recommended.

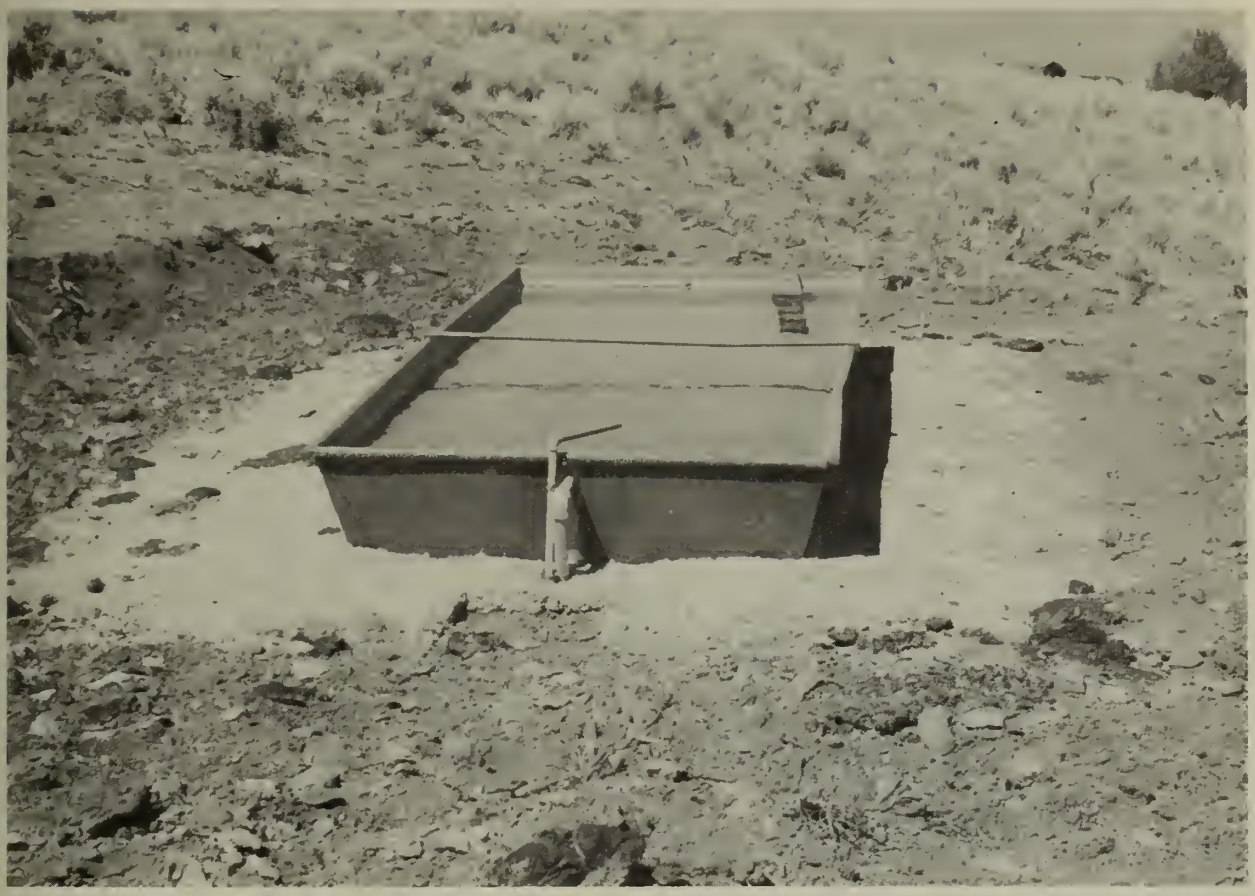
Trough Placement and detail

☆ GPO 853-660

PHOTOGRAPHIC

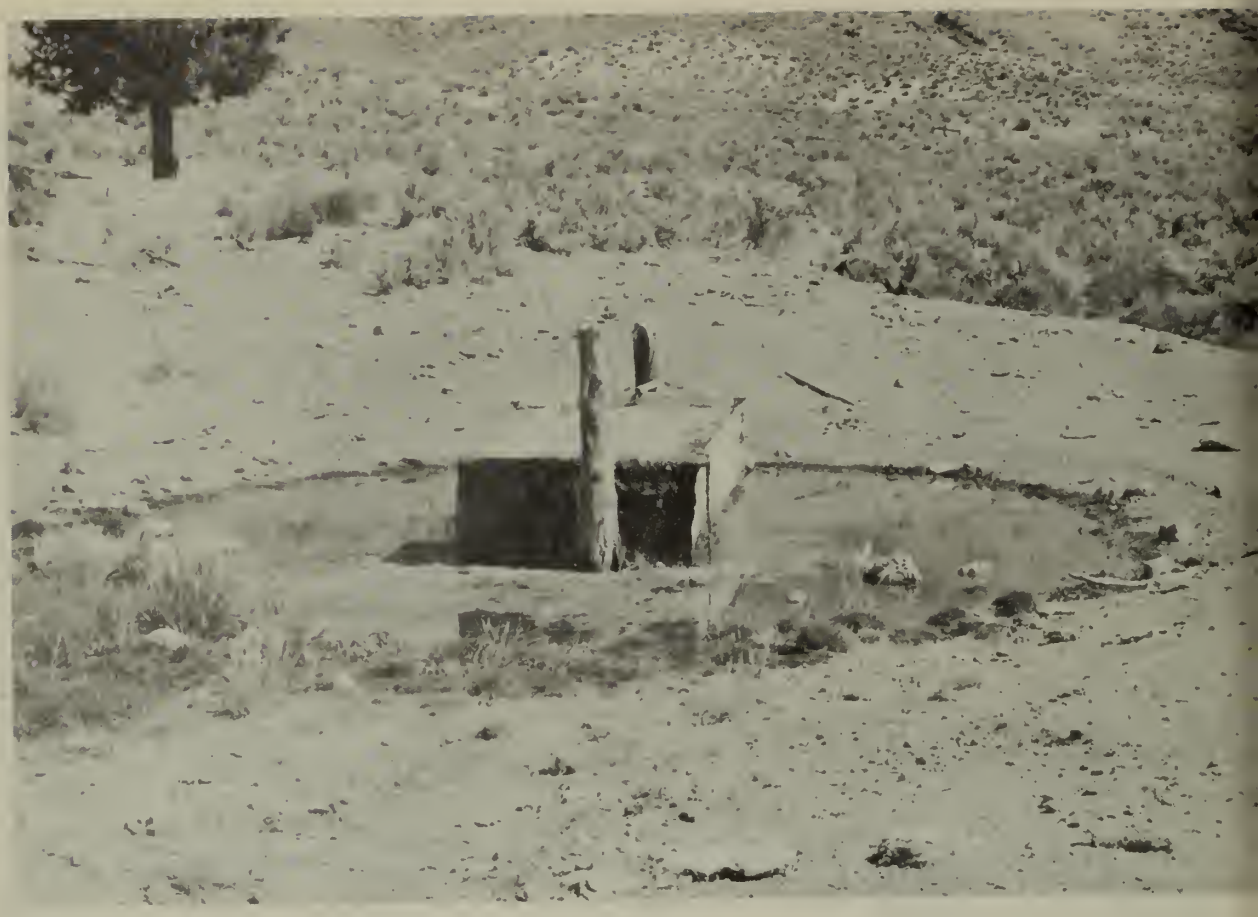
ILLUSTRATIONS

APPENDIX----II



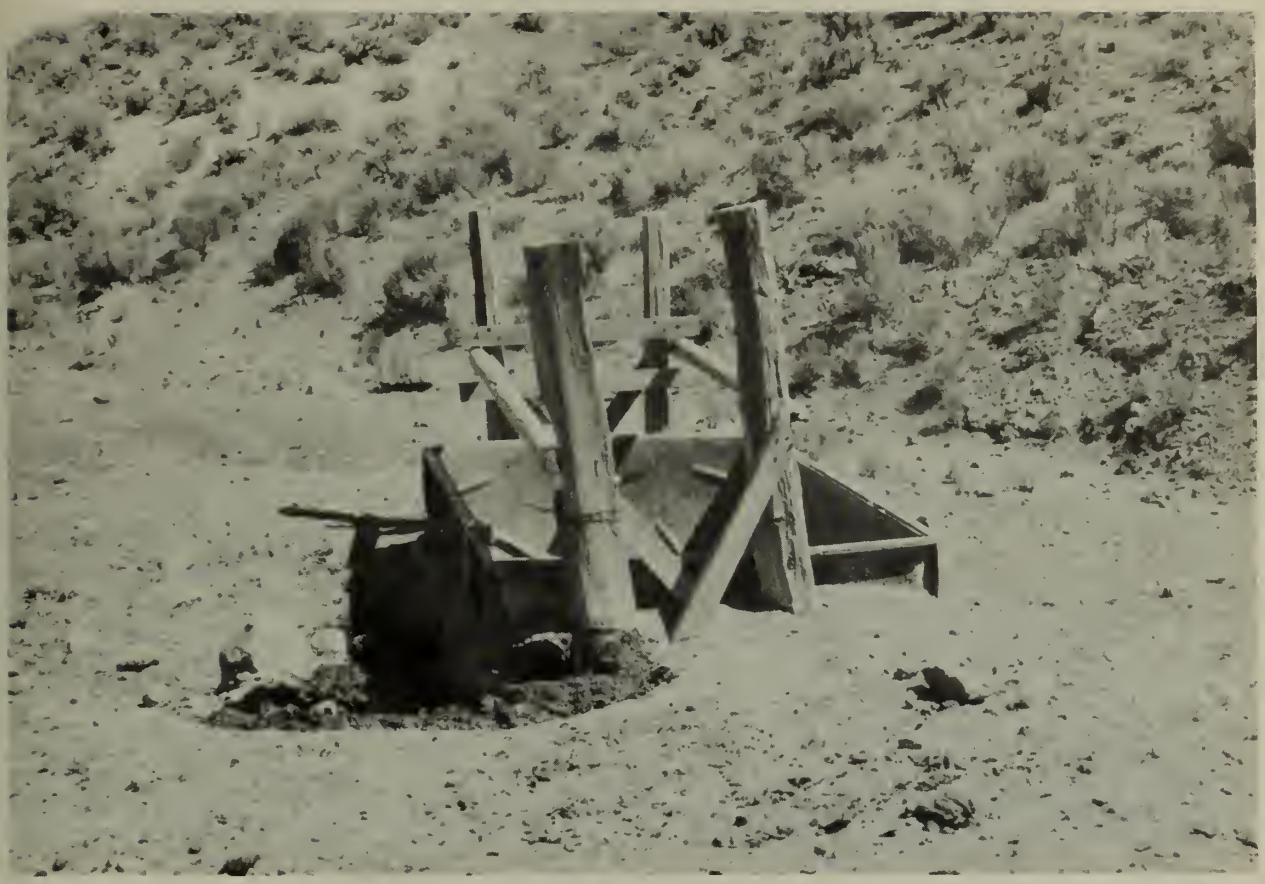
This trough has a capacity of about 750 useable gallons of water. It has been in place about three months. The rough surface of the concrete after more use will be practically undistinguishable from the surrounding soil. The back slope will probably assume a lesser angle of repose and revegetate naturally. The inlet could have been the same size of the outlet (1½"). If the installation had been critical in terms of public access, the inlet would have extended over the edge of the trough, down and into the water. This installation should prove to be essentially maintenance free.

Installation 1



Lack of water at this point is not a problem. The trough was originally placed on a mound but overflow combined with use has caused the trough to be a pedastal. The algae problem can be handled with certain chemicals or frequent cleaning. A concrete pad installed at time of the original construction would have prevented this problem. The additional cost would have been considerable cheaper than the maintenance that this situation requires.

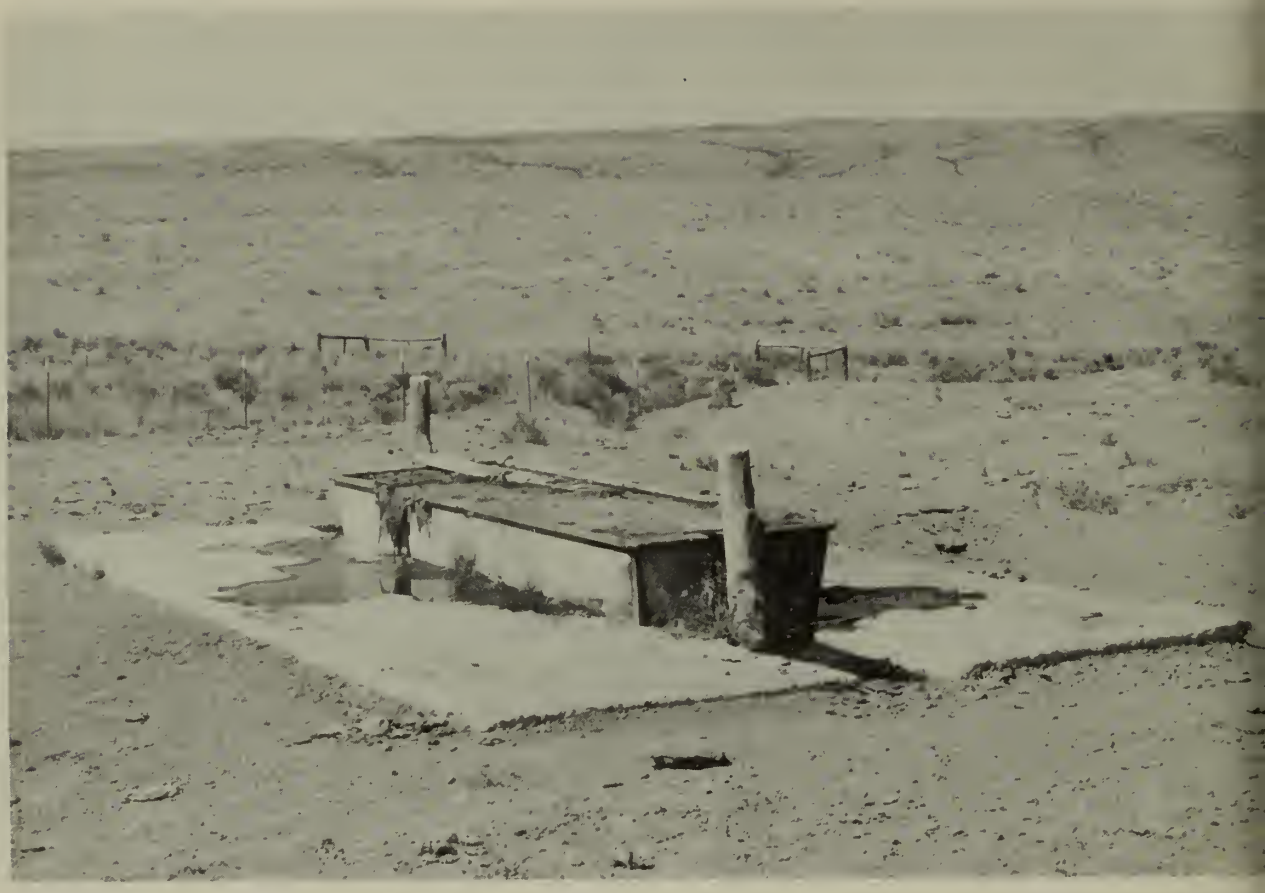
Installation 2



This trough has been improvised from half of a jet engine container. The round bottom makes the unit difficult to stabilize. Attempts to do so with the posts has failed. The wet spot in the left foreground is the result of the inlet line being ruptured. The trough is now dry and it is questionable whether a calf would be able to reach the water except at the near end. A few rocks have been placed near the tank in a feeble attempt to stop soil loss from the pad.

INSTALLATION 3

II-c



The algae problem has caused the trough to overflow. The maintenance will be limited to a few minutes with a stick or shovel to remove the algae. The enclosure in the background is the overflow site. Excess water from the trough flows into this area. Note the amount of vegetation and protection that is afforded small animals. Fence posts are convenient roosts for avian predators of small animals.

Maintenance

This collection trench in clay soil was excavated with a twelve inch backhoe. A narrow trench is adequate when shallow depth is required. Utilization of newer style continuous flexible perforated tubing allows greater flexibility in meandering the trench. Using a narrow bucket may not prevent environmental damage during construction, because greater problem exists where the excavated material is placed and the work area necessary on the opposite side of the trench.

Collection Trench

The trampling which occurred outside the exclosure accents the protection afforded the collection area. This area was back-filled, smoothed and reseeded after construction to install collection pipe. The headbox, is normally located near the center of the downhill side of the fence and marked with the project marker. No gates are allowed in the fenced area. The existence of gates would encourage entry and subsequent pollution of the area that is being protected.

Collection Area

II-f

A wide, deep cut-off trench is necessary to assure that all of the available water is channeled into the headbox. Generally, the trench should be dug to an impermeable layer. In most cases, the trench should be slightly lower than the bottom of the headbox or collection trench since these areas are dug to a depth lower than all visible spring sources. The trench shown above was backfilled with compacted clay.

Cutoff Trench

The poorly graded aggregate shown above is free of any clay or silt, but it would result in a plugged collection line or headbox.

The gravel shown here although not perfect, is clean and will not plug the collection or headbox facility. This is selected basaltic talis.

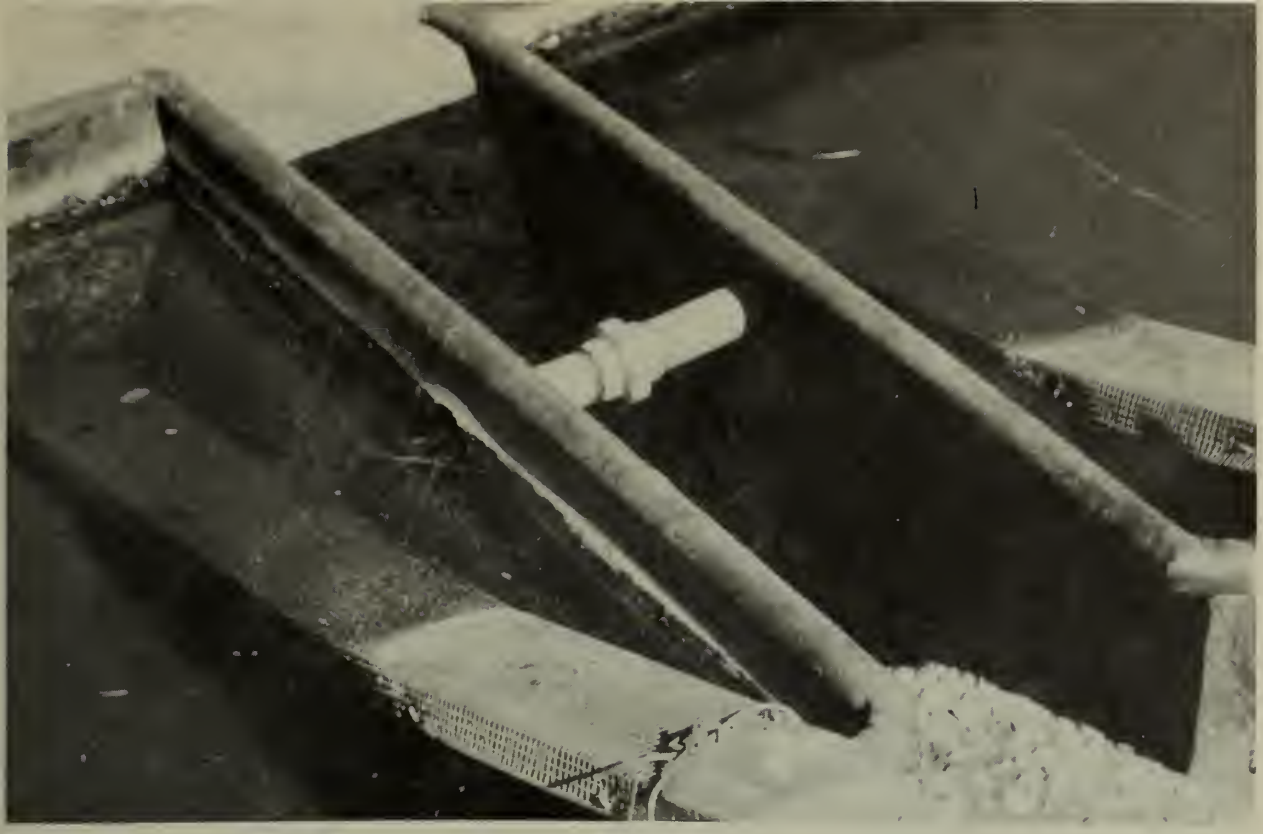
Inlet pipes should be oversized for the maximum flow and to allow space for air, silt, or other material that may find its way into the line. The cost of the extra line size is infinitesimal in comparison to the cost of one maintenance job.

The inlet should be securely fastened to the trough to prevent rupture of the line by livestock bumping or rubbing. The tank must be secured.

Inlet
II -i

This photograph shows one method of trough installation utilizing inlet, outlet and cleanout. Where freezing is a problem, consideration may be given to placing the inlet and outlet at the same end to provide circulation for the outlet. The hole in the outlet is essential to prevent air locks. The cleanout plug in the pipe is used if the overflow becomes plugged. A trough cleanout is necessary for cleaning the dirt and debris which collects over a period of time and will need to be removed to assure both water capacity and quality.

Plumbing Detail



Coupling two troughs together for more storage or space for watering can be accomplished as shown above. Attachment of the tanks with a union and two nipples is difficult because sleeves are welded into the tank at right angles to the sloped end of the trough. Two short nipples, a piece of radiator hose, and two clamps are easier to install.

Couplings may be used at the bottom of the trough where severe freezing and low flows are anticipated.

The space between tanks should be such that calves cannot wedge into the opening.

The small game ramps shown here are only one of many types. The mesh provides adeuate traction and the slope is reasonable for birds and small mammals to get out. The board is fastened securely to the trough to prevent displacement by stock.

Trough Collection
and
Small Game Ramps

This type of structure can be utilized as a positive type outlet protector if a fence is not required. The structure requires adequate strength to resist rubbing by stock. Note the vertical posts are treated to resist the constant presence of moisture around the outlet. Structures such as this will prevent plugging the overflow outlet through displacement or trampling by stock.

Outlet Protective Structure

BEAR CAT SPRING
Developed by the Bureau of Land Management in cooperation with the Oregon State Game Commission to provide water for livestock and wildlife

Signs can be placed in a protected area to prevent damage by stock. Signs should be made of a durable material requiring little or no maintenance. This sign denotes a cooperative effort but has little actual value. Note that the posts have been used for bird roosts, which may not be aesthetically pleasing.

Sign and Outlet Protective Area

Construction debris such as this pile of excess concrete is not aesthetically acceptable, serves no purpose, and is conspicuous in the surround environment. Excess construction material should be buried, burned (if permissable), or removed from area and placed in an approved dump.

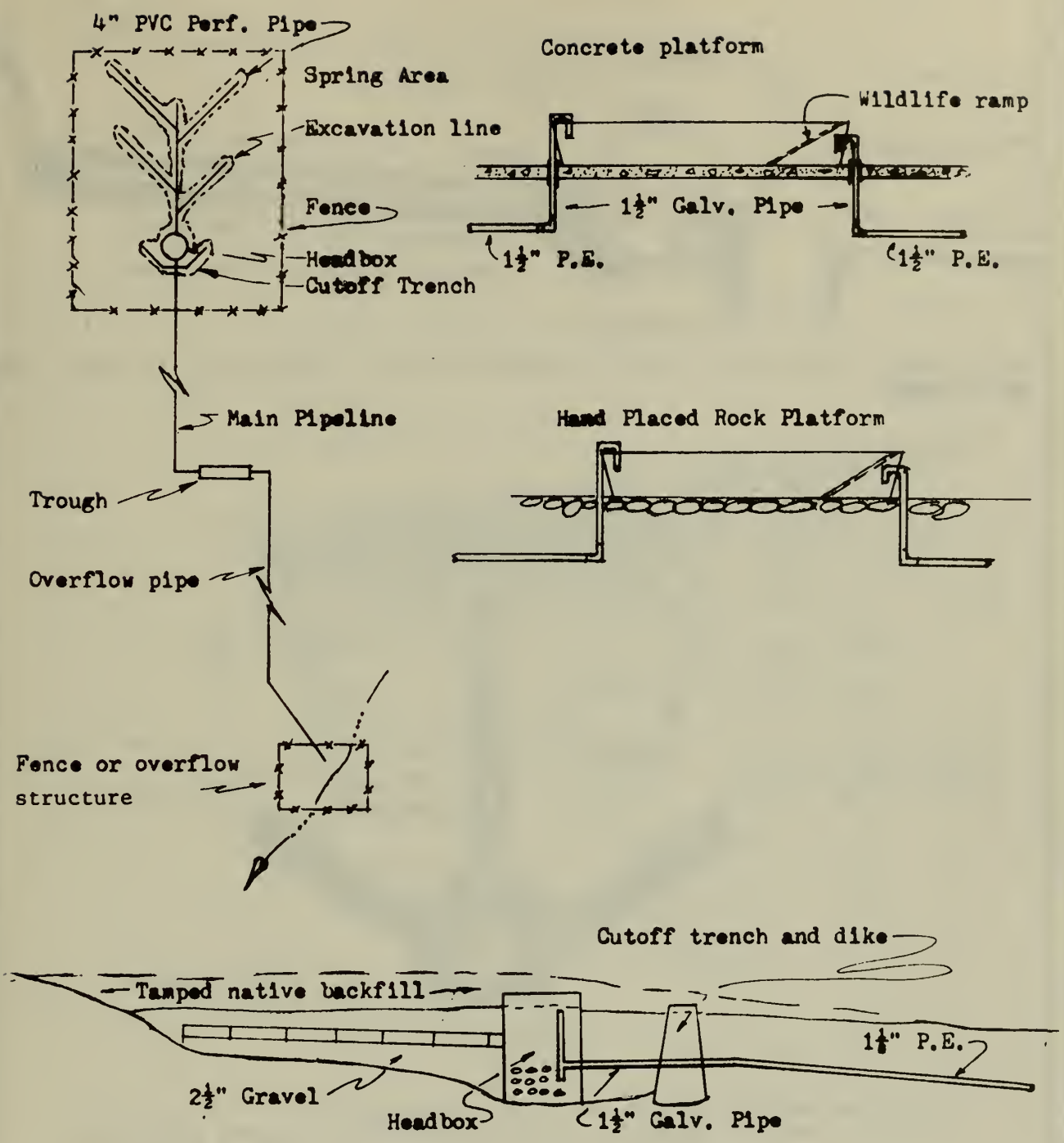
Construction Debris

This front-end loader with a backhoe attachment can be economically utilized on the development of most springs. Whatever equipment is utilized, it pays to handle and maintain the equipment in a safe and efficient manner. Accidents and poor operating maintenance of machinery is costly in terms of lost time, repair and is sometimes even painful.

TYPICAL

DESIGNS

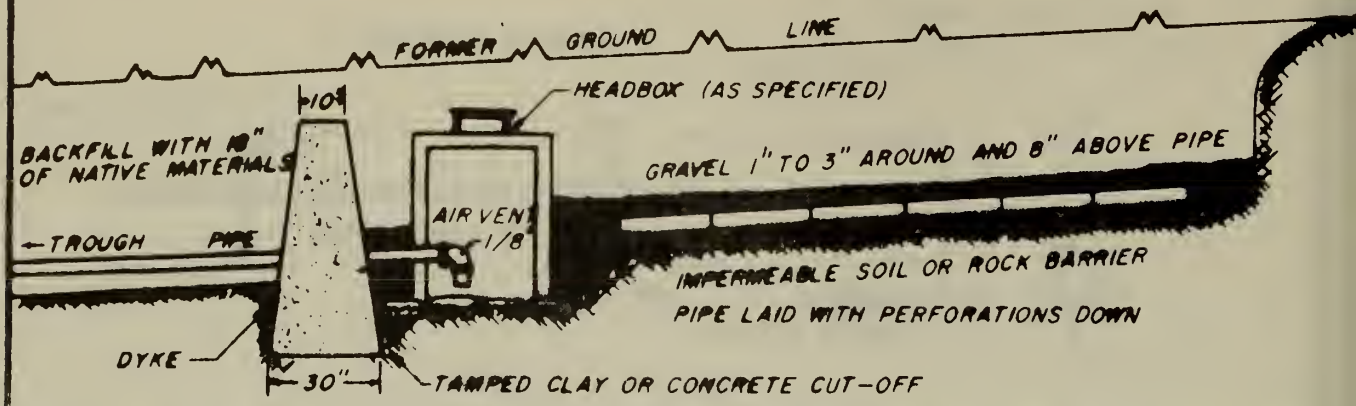
APPENDIX----III



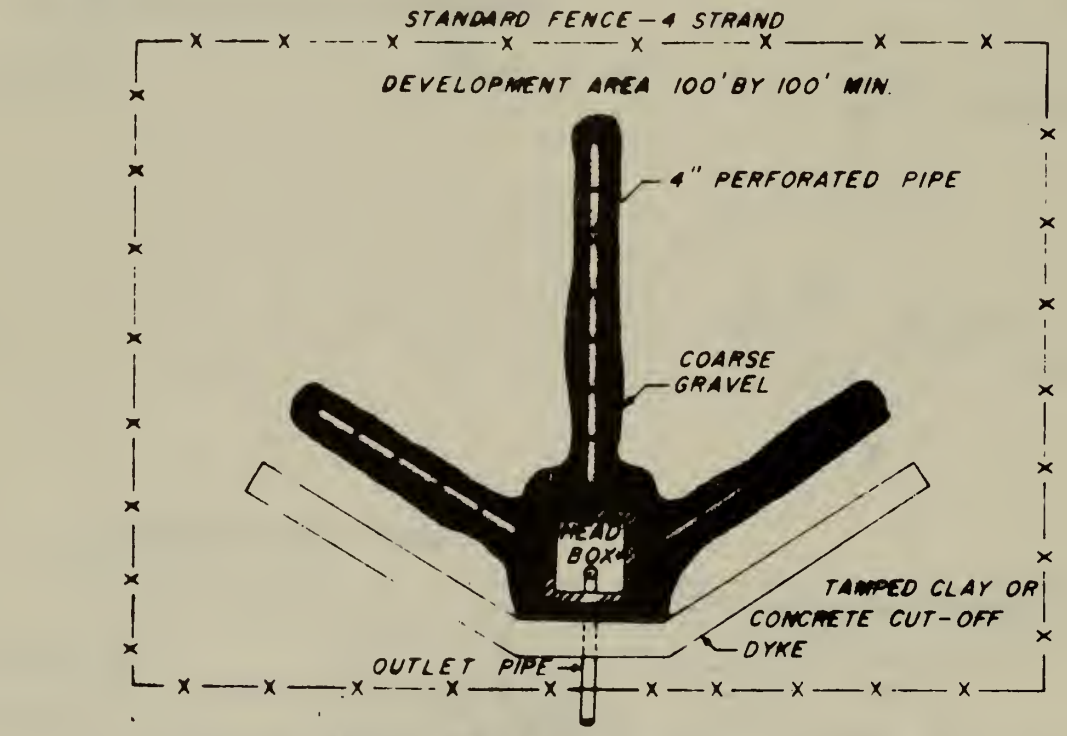
Typical Plan & Detail

III-a

☆ GPO 853-660



DYKE EXTENDS 1' BELOW AND 2' ABOVE IMPERMEABLE BARRIER INSTALL ONLY IF WATER CANNOT BE RETAINED.

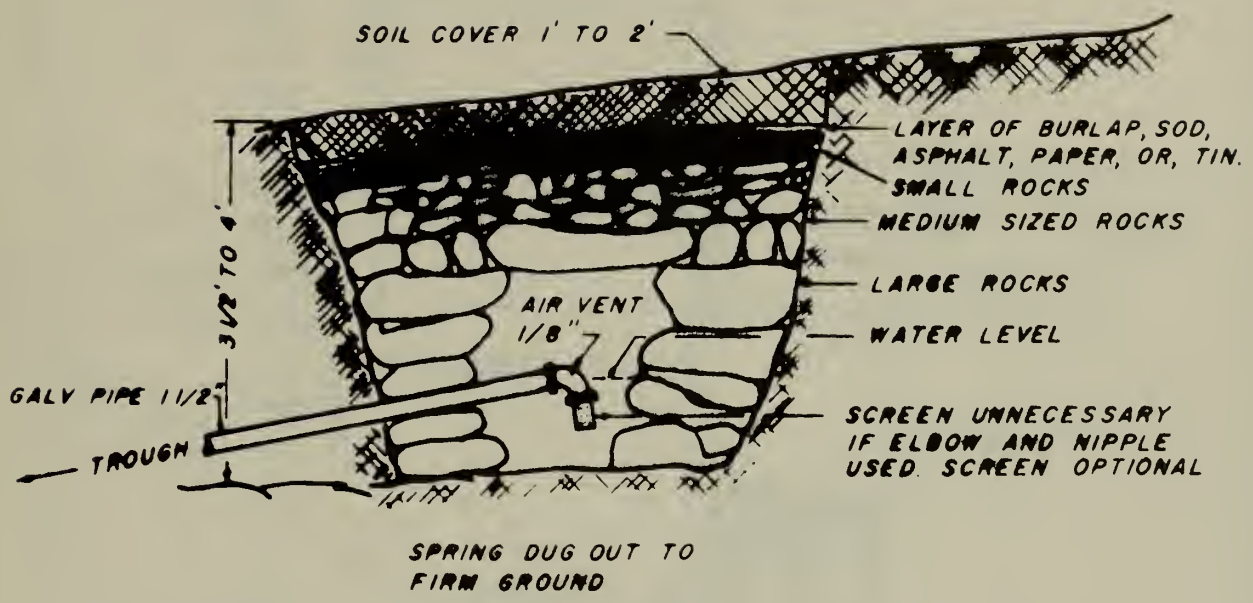


COLLECTION PIPES — 4" PLASTIC OR FIBER OF GOOD QUALITY
COLLECTION BOX — 36" DIAMETER CONCRETE PIPE OR 36" DIAMETER CORRUGATED CULVERT WITH PERFORATED BOTTOM — OUTER 10 INCHES

Bog Spring

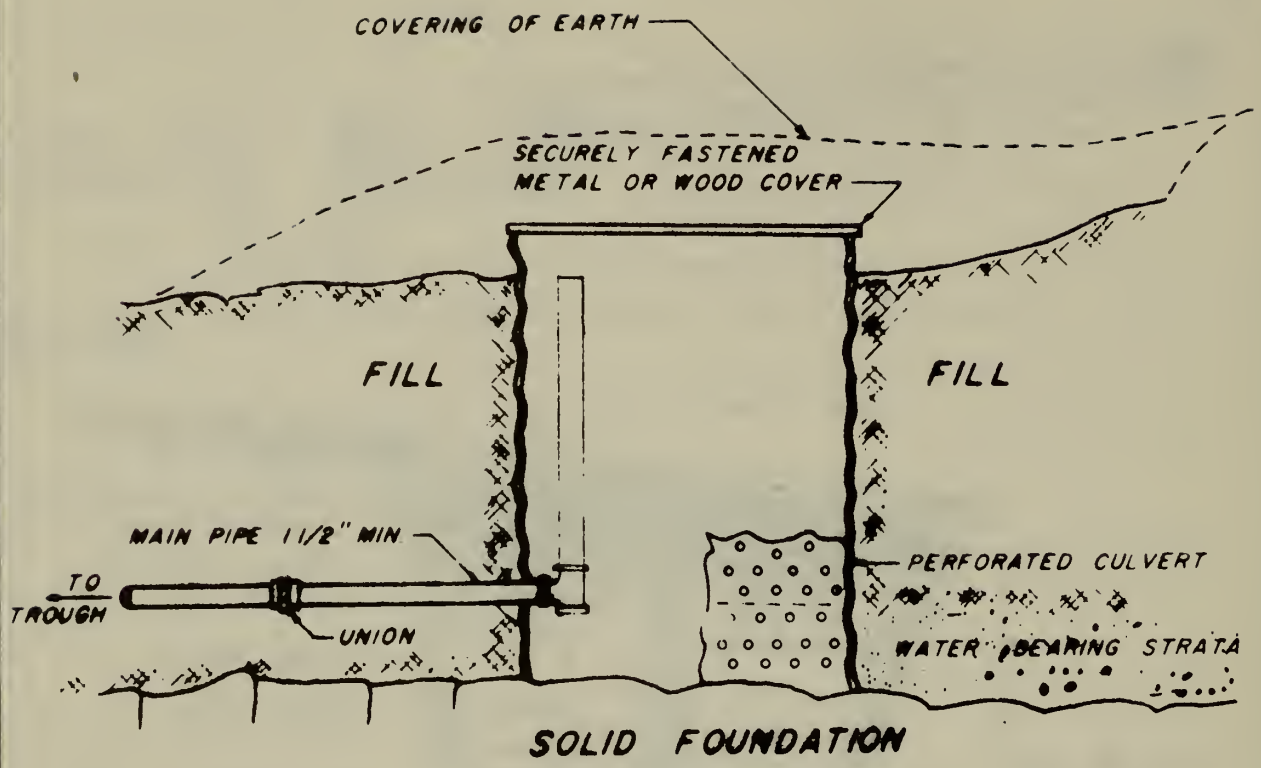
III-b

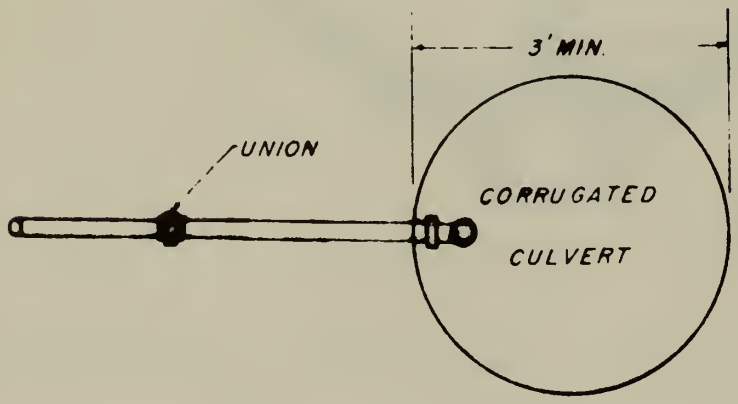
★ GPO 888-889


SOIL COVER 1' TO 2'
LAYER OF BURLAP, SOD, ASPHALT, PAPER, OR, TIN.
SMALL ROCKS
MEDIUM SIZED ROCKS
LARGE ROCKS
WATER LEVEL
AIR VENT 1/8"
3 1/2' TO 4'
GALV PIPE 1 1/2"
TROUGH
SCREEN UNNECESSARY IF ELBOW AND NIPPLE USED. SCREEN OPTIONAL
SPRING DUG OUT TO FIRM GROUND

Rock Headbox

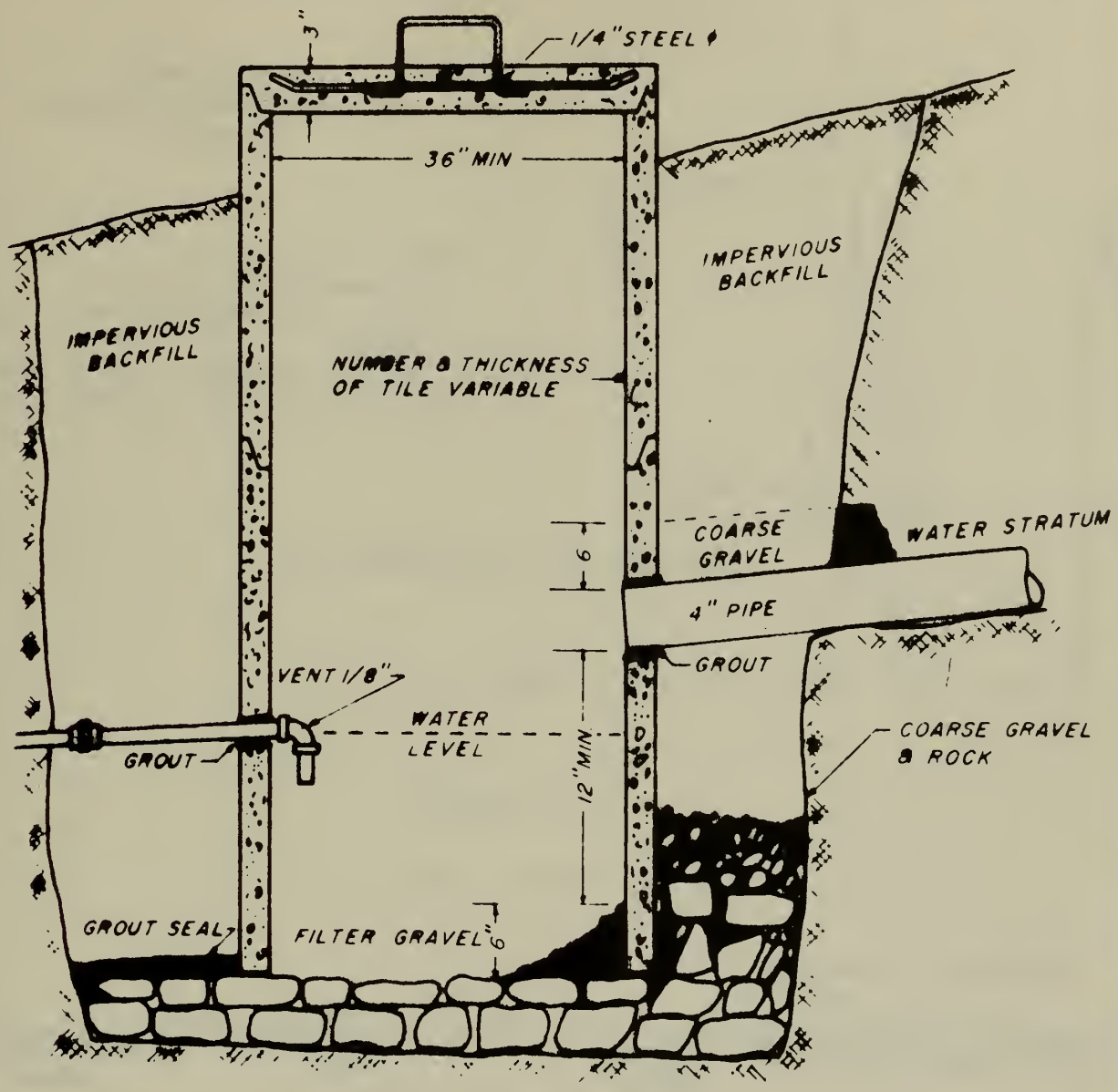
III-c





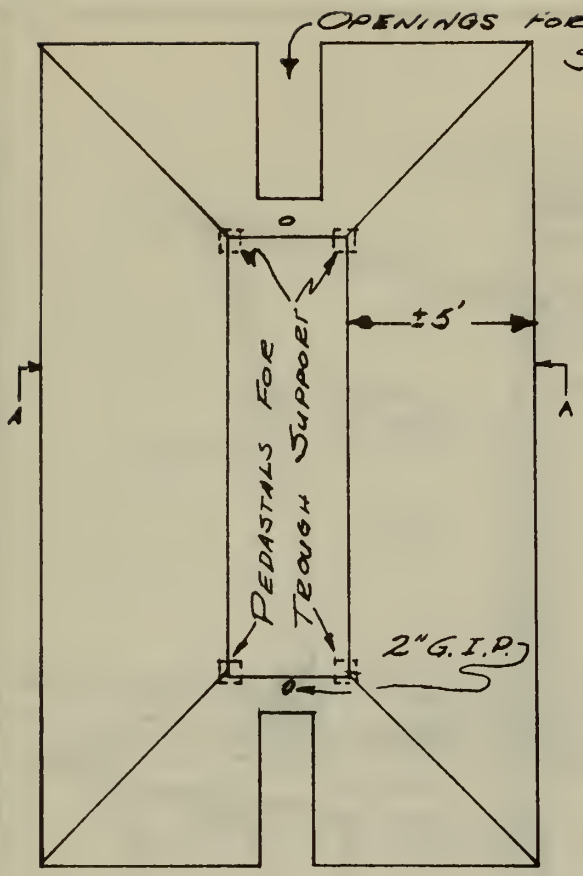
Culvert Headbox

III-d



Concrete Headbox

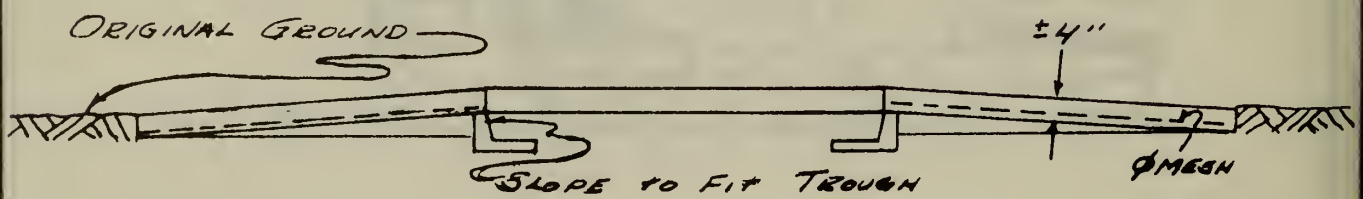
III-e



CONCRETE BASE
FOR STOCK WATERING TROUGHS
750 Gallon

Bill of Materials
3.4 Cubic Yards Concrete
1 94" x 100" Polyethylene Plastic Sheet
2 6" x 2" Inside Dia. Galv. Pipe
290 Sq. Ft. 6" x 9" Reinforcing Mesh

SECTION A-A



The perimeter of the slab shall be installed flush with the existing ground surface. The centre of the slab shall be installed on the surface, and the footing for the stock tank will extend into the existing ground.
Place a seamless 10 mil. Polyethylene plastic sheet over the bottom, sides, and ends of the stock tank and position the tank into the concrete slab. Trim off excess plastic flush with the slab.
Backfill the slots in the ends of the slab with 4" minus aggregate, to a depth 6" below the surface of the slab, after installation of the water lines.
The 2" inside diameter galvanized pipe shall extend 2" above and below the concrete slab. Thread to standard pipe fittings on both ends.
The surface of the concrete slab shall have a roughness not greater than 1" between the bottom of the depressions and the tops of the ridges.
Prior to placing concrete lay the reinforcing mesh and support 1" above the ground. Do not allow the mesh to extend closer than 1" toward any end or side.

BID SCHEDULE AND SPECIFICATIONS

-An Example-

APPENDIX----IV

BID SCHEDULE

SPRING DEVELOPMENT AND MAINTENANCE

Furnish all labor, supervision, equipment, fuel, lubricants, small tools and transportation necessary for the performance of all work incidental to Spring Development and Maintenance with Government furnished materials (except as specified herein) in Harney and Grant Counties as identified on the attached Work Location Map.

SCHEDULE A

Item No.	Description	Estimated Quantity	Unit	Unit Price	Amount
	SPRING DEVELOPMENT (Jackass and Big Pine Spring)				
1.	Collection Trench Construction and Pipe Installation	290	Lin.Ft.	$_____	$_____
2.	Headbox Installation	2	Each	$_____	$_____
3.	Pipeline Installation (1½" PE)	336	Lin.Ft.	$_____	$_____
4.	Trough Installation	4	Each	$_____	$_____
5.	Fence Construction	60	Rods	$_____	$_____
	Schedule A, Total Bid (Items 1 thru 5) ALL OR NONE				$_____

Performance time: 36 calendar days.

SCHEDULE B

Item No.	Description	Estimated Quantity	Unit	Unit Price	Amount
	SPRING DEVELOPMENT (Grasshopper Spring) SPRING MAINTENANCE (Bearcat & Davis Spring)				
1.	Collection Trench Construction and Pipeline Installation	452	Lin.Ft.	$_____	$_____
2.	Headbox Installation	3	Each	$_____	$_____
3.	Pipeline Installation (1½" PE)	1085	Lin.Ft.	$_____	$_____
4.	Trough Installation	6	Each	$_____	$_____
5.	Fence Construction	116	Rods	$_____	$_____
	Schedule B, Total Bid (Items 1 thru 5) ALL OR NONE				$_____

Performance time: 48 calendar days.

PERFORMANCE TIME: Concurrent performance on Schedule A and B will be required should both items be awarded to one Contractor. 48 calendar days to perform both schedules will be allowed.

SPECIFICATIONS FOR PIPELINE SPRING AND WATERING FACILITIES

1. Requirement. It is required that the installation of pipeline(s), development of spring(s) specified in the Bid Schedule and herein be performed at the location(s) shown on the attached Work Location Map, in accordance with the contract, including the General Provisions, the Additional General Provisions, these Specifications, and such other terms and conditions which are made a part hereof.

2. Description of the Work. The work consists of the development of spring(s), construction of pipeline(s), and watering facilities described on the attached drawings and Bid Schedule made a part of this invitation and any contract resulting therefrom.

3. Staking. The Government will locate the pipelines with stakes at angle points, ends, and within a slight distance between angle points. The work shall be in conformity with the stakes. The Contracting Officer will designate the location of all accessory facilities, such as trough site; and drain, air relief, shut-off, pressure relase, flow controllers and blow-out valves. The Contractor shall protect all location and construction stakes until no longer needed and shall protect public land corners, or other permanent reference marks or stakes from damage or removal. In case of their destruction or removal by the Contractor, the stakes will be replaced by the Government and the actual cost to the Government for replacement will be deducted from payments due to the Contractor.

4. Site Preparation and Access Roads. The pipeline right of way shall be cleared by the Contractor. Contractor may clear the right of way by removing all brush for a distance of four (4) feet maximum from each side of the pipeline, taking special

care not to disturb anymore surface than necessary. The Contractor may construct access roads to the sites and along the pipeline right of way only with written approval of the Contracting Officer. The cost of site preparation and construction of access roads shall be included in the unit price bid in the schedule for "Pipeline Installation," "Spring Box Installation," " Trough Installation," etc.

5. Materials. The contractor shall pick up all materials furnished by the Government at the BLM yard, Filmore Street, Burns, Oregon. Materials will be available between 9:00 AM, and 4:00 PM except Saturdays, Sundays, and legal holidays. Contractor shall load and transport all materials to the work site, and furnish labor and equipment to construct the pipeline as specified. The contractor shall be responsible for all material in his custody until the pipeline is completed and accepted. All unused materials shall be returned by the Contractor to the location from which they were received or nearer destination if so directed by the Contracting Officer. The cost of picking up and transporting the materials to and from the project site shall be included in the unit price per foot bid in the schedule for pipeline installation.

The Government will furnish all required materials except the following:

a. Forming lumber,
b. Reinforcing mesh or bar,
c. Concrete,
d. Hand placed rock (Rock available at the worksite)
e. Aggregate.

General - All material required for the construction of the pipeline(s) that are furnished by the Contractor shall be new,

undamaged, and of the best quality of their respective kinds. Concrete materials shall be described in Specification E-4, "Concrete Construction."

All pipe shall be protected against damage by freezing, traffic, and heat.

Costs - The cost of furnishing and delivering all materials to the jobsite shall be included in the unit price bid in the Schedule for "Pipeline Installation," "Spring Box Installation," "Trough Installation," etc.

6. Collection Trench Construction and Pipe Installation. Trenches for collection laterals shall be excavated and backfilled by hand shovel, or backhoe with a bucket not exceeding twelve (12) inches in width. Four (4) inch perforated plastic pipe shall be installed as shown on drawings.

Clean gravel 2½ inch to ½ inch free of any fines will be filled in around the perforated plastic pipe to eighteen (18) inches above and four (4) inches below. Ten (10) mil plastic sheeting will be laid over the gravel and the excavation backfilled with native soil. No backfilling shall be done without approval of the Contracting Officer.

Payment will be made for the actual units installed and operating at the unit prices bid for "Collection Trench Construction and Pipe Installation."

Such payment shall be full compensation for the cost of the construction of access roads, site preparation, materials furnished by the contractor, transportation of materials, and all labor necessary to properly install the pipe.

7. Spring Box Installation. The Contractor shall do all work necessary to develop the spring(s) so that a maximum flow of

water is obtained and collected into the headbox. After completion, the surface around the headbox must remain dry. Work required will include excavation for and installation of headbox(es), installation of all pipe fittings, and construction of cut-off trench and dyke.

Clean gravel 2½ inch to ½ inch free of any fines will be filled in around the headbox to above the perforations and along the collection lines to eight (8) inches above the perforated pipe. Ten (10) mil plastic sheeting will be laid over the gravel and the excavation backfilled with native soil. The headbox will be covered with a minimum of six (6) inches of native soil.

Upon encountering unusual conditions during excavation for the headbox, the Contractor may request permission to reduce the headbox height to a depth not less than twenty (20) inches. The headbox must be rescaled and appear exactly as it did prior to shortening, except for the length. Upon approval from the Contracting Officer, the Contractor may proceed with the alteration. No additional cost shall be assessed the Government for said alteration.

Where existing troughs are to be used, the Contractor shall modify by cutting and bracing all fitting sizes to comply with specifications indicated on typical drawings.

All installed facilities shall be inspected by the Contracting Officer prior to backfilling.

Work indicated in this item shall be done in accordance with the specifications shown on drawings. Payment will be made for the actual units installed and operating at the unit prices bid for "Spring Box Installation."

Such payment shall be full compensation for the cost of the con-

struction of access roads, site preparation, materials furnished by the contractor, transportation of materials, and all labor necessary to properly install the spring box.

8. Pipeline Installation.

(a) Placement--Plastic polyethylene pipe may be laid with ripper and attachment or in an excavated trench and backfilled. Polyethylene pipe must be laid in a trench in snakelike fashion. Steel pipe shall be laid in a trench. All pipe must be buried a minimum of eighteen (18) inches as measured from the top of the pipe.

If a ripper and attachment is used, a minimum of one pass with the ripper to the required depth shall be made prior to ripping and placing the pipe. The ripper attachment shall have a pipe lead of not less than 3½ inches diameter, with a bend radius of not less than 18 inches. If a trench is dug, it shall be not less than six (6) inches nor more than twelve (12) inches wide.

Pipe sections to be laid under stream channels shall be placed in ten (10) inch concrete pipe, 20 feet in length. Top of the concrete pipe shall be a minimum of 30" below bottom of stream channel.

The pipe shall not be unrolled or laid when the temperature exceeds 95°F. or is less than 50°F. The end of the PE pipe shall be softened with heat before inserting fittings. All fittings shall be properly installed in a workmanlike manner and no damage shall be done to the pipe. No tension shall be placed on the pipe during laying operations.

(b) Valves--Installation shall conform to Specifications indicated on drawings. Valve boxes of the type shown shall be installed with all valves.

(c) Testing--The Contractor shall test the pipelines for leaks. After all accessories are in place, the pipeline shall be filled with water and held at the operating pressure, or ten feet of head, whichever is greater, for a minimum of three hours. If leakage is evident, the pipeline shall be repaired and the test repeated. The Contracting Officer shall be present during all testing procedures.

(d) Backfill--After the pipeline has been laid with a ripper and attachment and tested, the trench shall be backfilled or closed by:

1. Having the tractor wheel or track run on each side of the pipeline so as to squeeze the trench shut, or
2. By dragging a disc or other equipment over the ditch.

If the pipeline is laid in an excavated trench, only the materials which passes a No. 4 sieve shall be placed within two (2) inches of the pipe. The remainder of the backfill may be unclassified material originally excavated from the trench.

The trench must be completely filled.

If rock is encountered, the backfill shall be placed so that the pipe will be covered a depth equal to that stated in Paragraph 8 and two (2) feet on each side of the pipe. Rocks twelve (12) inches or more in any dimension shall be removed and discarded.

(e) Payment--Measurement for payment shall be the actual length of pipeline in placing including couplings, drain, air relief, shut-off, pressure release, flow controllers, and blowout values measured to the nearest foot.

Payment for pipeline installation will be at the unit price bid in the schedule for "Pipe Installation."

Such payment shall be full compensation for the cost of the construction of access roads, site preparation, materials furnished by the contractor, transportation of materials and all labor necessary to properly install the pipeline.

9. Trough Installation.

(a) General--Watering facilities shall be constructed or installed at locations staked by the Government and in accordance with the drawings.

(b) Concrete--The concrete shall be prepared as described in E-4 "Concrete Construction" and placed as shown on the drawings.

(c) Fabrication--If the watering facilities are to be fabricated from several parts, the bolts shall be tight and all seams made water-tight. They shall be fabricated as shown on the drawings and as recommended by the manufacturer.

(d) Placement--If the watering facilities are set in the concrete, they shall be securely braced so that no movement will occur for a minimum of three (3) days and the concrete has properly "set." All facilities shall be set level.

Platforms shall be hand placed rock or concrete as shown on the Work Summary Chart and in accordance with the drawings.

Hand placed rock work shall consist of furnishing and placing rocks approximately 4" x 12" x 15" for a width of five (5) feet on each side and each end of the trough. Rocks shall be 1½" apart at the closest point. Soil shall be compacted between rocks. Rocks and soil shall be placed so that the ramp is smooth in appearance with a slope outward from the trough equal to one inch per foot. The required rock shall be selected from the vicinity of the "Trough Installation."

(e) Each trough will contain one 2" x 6" board, 6' long, covered with ¼" mesh screen. The 2" x 6" so covered will extend from the edge of the trough to the bottom of the trough in such a manner as to expedite escape from drownings by small animals.

(f) Rectangular trough installation not placed in concrete will include placement of four (4) steel posts, one driven at each corner of the trough, deep enough so that no more than four (4) inches or less than two (2) inches extend above the trough edge. Two (2) strands of wire will be stretched tight between the end posts to prevent displacement of the trough from the original placement.

(g) Payment--Payment will be made for the actual number of units in place and operating at the unit price bid in the schedule for "Trough Installation." Such payment shall be full compensation for cost of the con-

struction of access roads, site preparation, materials furnished by the contractor, transportation of materials, and all labor necessary to properly install the trough. Section 14, Payment, of Form 9172-16, E-4 "Concrete Construction" is deleted. Payment for concrete will be included in the unit price bid in the schedule for "Trough Installation."

10. Fence Construction. Specification F-3 "Fence Construction" shall be modified to include removal of existing fencing and clean-up old materials where indicated on the work summary chart. Payment for fence removal and clean-up old materials shall be included in the unit price bid for "Fence Construction."

11. Outlet Fence. Overflow fences shall be constructed in accordance with the drawing, "Typical Overflow Fence." Payment will be made for actual units installed at the unit price bid for "Outlet Fence."

ER'S CARD

1973

ment

	OFFICE	DATE RETURNED

(Continued on reverse)